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ABSTRACT

This study investigated how academic norms, expectations and rules affect the experiences of graduate students, particularly in regards to reported academic misconduct at disciplinary and departmental levels. The study used a hierarchical linear analysis with data from a nationwide survey of 2,000 graduate students in chemistry, civil engineering, microbiology, and sociology. The survey asked participants about their doctoral programs, academic and social experiences in their departments, their mentors, and experiences with ethical issues and research misconduct. The analysis suggests that the most localized contexts in which graduate students live, the discipline and department, have a great impact on their exposure to misconduct, which appears to be a profound socialization experience. Rates of observed misconduct appear to be department and discipline specific, and alterable characteristics of departmental environments condition the exposure of graduate students to a wide array of different forms of behavior that conflict with the image of "the good scientist." Two appendixes present additional technical information about the survey. (Contains 36 references.) (JB)

Disciplinary and Departmental Effects on Faculty and Student Misconduct

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This paper was presented at the annual meeting of the Association for the Study of Higher Education held at the Marriott City Center, Minneapolis, Minnesota, October 29 - November 1, 1992. This paper was reviewed by ASHE and was judged to be of high quality and of interest to others concerned with the research of higher education. It has therefore been selected to be included in the ERIC collection of ASHE conference papers.

Abstract

This paper investigates disciplinary and departmental effects on reported levels of academic misconduct. It presents a theoretical framework for examining misconduct in the context of the implicit "academic contract" that underlies the work of academic researchers. Three forms of misconduct are specified here: research, employment, and personal. Through a hierarchical linear analysis, these three types are related to differences in academic discipline, departmental structure, and departmental climate, controlling for relevant characteristics of individuals. Data from this study are drawn from a nationwide survey of graduate students in chemistry, civil engineering, microbiology, and sociology.

In this paper we examine the impact of the organizational context of socialization on the experiences of graduate students in the sciences and social sciences. The main focus of the paper is the degree to which the characteristics of socialization settings are associated with student observations of scientific misconduct, where the term misconduct is broadly defined.

A Framework for Investigating Socialization in the Sciences

This paper is centrally concerned with the question of how academic norms, expectations and rules affect the experiences of graduate students. Academic research is conducted in a context that is negotiated both explicitly and implicitly. The broad social context imposes standards and expectations of conduct: society accords the professor a certain degree of freedom, and in return expects that the individual will not only observe its civil laws and behavioral norms, but also prove worthy of the trust and reliance that his or her expertise elicits (Rosenshine, 1983).

Within the social context lies the narrower context of the academic enterprise. By this we mean the aggregation of higher education institutions and all other organizations and agencies involved in the pursuit or support of academic research. Expectations here center around the professor and student as a member of the academic community. Widely shared conceptions of the proper role and activity of an academic researcher form the basis for the negotiated conditions for research at this level. In the not-too-distant past, the university and peer review groups at the national level constituted the relevant institutional environment. More recently, however, a variety of federal, state and even local actors have become involved in regulating academic behavior (Anderson and Louis, 1991).

Two components of the researcher's immediate work environment shape expectations and behavior. First, some have argued that the academic discipline plays a major role in shaping a professor's perspective on what lines of inquiry are to be pursued and how the research should be carried out (Kerr). Through discipline-specific education, socialization, disciplinary codes of conduct, and conferences or other meetings, the researcher becomes aware of standards of behavior and expectations rooted in his or her specific field of study.

Faculty and students also negotiate a more immediate professional environment in an academic department. While many aspects of the professor-department relationship are specified in an employment contract and in formal regulations and procedures, other factors, such as departmental climate and structure (Ashforth, 1985; Louis et al., 1987), influence the conditions under which researchers work. The disciplinary and departmental contexts intersect in the sense that some aspects of the research environment are related to disciplinary influences at the department level. Some aspects of department life, however, are independent of the disciplinary association, and therefore we do not conceptualize departments as contained within the disciplinary context.

We summarize these four contextual levels of academic work in Figure 1. Together, the expectations, requirements, standards, regulations, and other formal and informal conditions of academic work constitute part of an implicit academic contract to which individual professors agree. In return, faculty have traditionally been granted a large measure of freedom in the pursuit of research and in teaching, on the assumption that their training and expertise prepare them for the tasks, privileges, and responsibilities of academic work. One arena of freedom has been the design of processes for inducting new scientists into the field. While the institutional context regulates formal requirements, such as number of course credits, the detailed content and structuring of socialization settings for graduate education is largely a matter that is left to faculty and the disciplines.

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Scientific Misconduct

Misconduct has become a significant concern for both the scientific community and the federal government in recent years (Beardsley, 1992; U.S. Government Printing Office, 1989; 1988; Stewart and Feder, 1987; Chubin, 1985). Although the exact number of cases of scientific misconduct is currently difficult to ascertain, some argue that it is a much wider spread phenomenon than was once thought (U.S. Government Printing Office, 1988). A number of nationally prominent scientists in the past decade have been found guilty of misconduct (Chop and Silva, 1991; Fox, 1990; Goodstein, 1990). In a study reported in the New England Journal of Medicine (Shapiro and Charrow, 1985), the FDA found 41 cases of verified scientific misconduct between 1977 to February of 1983. Richard Kusserow, Inspector General of the Department of Health and Human Services notes that at least half of the top 50 research institutions in the country have conducted investigations for scientific misconduct in recent years (Holthaus, 1988).

The consequences of this level of scientific misconduct can be considerable. Most scholars concerned with misconduct emphasize its impact on the societal and institutional context for academic work. Chubin (1985) suggests that misconduct slows the progress of science, questions the trust the general public places in the scientific community, and misuses the considerable amounts of money provided by the public to science. In addition, in the health sciences there are potential consequences for patients who receive improper treatment springing from fraudulent research results (U.S. Government Printing Office, 1988). Others have also noted the difficulty in correcting scientific literature once erroneous results are published (Friedman, 1990; Garfield, 1990).

Attempts to control misconduct has also resulted in an increase in the number of active players within the institutional context. The federal government has stepped in to investigate instances of scientific misconduct and also recommend policies (U.S. Government Printing Office, 1988; 1989; Palca, 1990). For example, the National Institutes of Health (NIH) has attempted to develop guidelines for "guard[ing] against conflicts of interest in federally funded research" (p. 154, Palca, 1990). Professional associations such as the American Association for the Advancement of Science and the Association of American Medical Colleges have met to develop their own guidelines to assure ethical behaviour in scientific work (AAMC, 1990; Chubin, 1985, Culliton, 1988). There has been renewed interest in developing more explicit policies for dealing with their faculty regarding scientific misconduct (Nobel, 1990; Freidman, 1988), and studies of peer review, the traditional academic control mechanism thought to curtail scientific misconduct (Cantekin, McGuire, and Potter, 1990; Singer, 1989; Berarado, 1989).

However, an important focus for controlling future scientific misconduct that has yet to receive a great deal of attention is the initial training or socialization of scientists, in which the discipline and the department are the most critical actors, as argued above. There is evidence indicating that, during the socialization phase of a career, people internalize important value orientations toward their work (Van Maanen and Schein, 1979). In particular, socialization research from higher education suggests several significant factors that effect the internalization of values by graduate students: the nature of the academic discipline, the structure and climate of the academic department, and the level of mentoring students received from faculty (Louis and Anderson, 1991).

Academic Disciplines

Academic disciplines play an important role in the values and beliefs that graduate students acquire during their socialization. For many graduate students, the primary motivation for entering the academic profession is the lure of working in a particular discipline (Ruscio, 1987). Even more importantly, a number of researchers have found that academic disciplines have, in addition to their bodies of technical knowledge and skills, distinct cultures (beliefs, norms, values, patterns of work and interpersonal interaction; Becher, 1987). These distinct cultures differentially determine the behaviour of individuals within each discipline (Becher, 1987; Clark, 1987). During their graduate training, student scientists-to-be are slowly brought into these different cultures (Clark, 1987; Becher, 1987). These cultures vary by work "assignments, symbols of identity, modes of authority, career lines, and associational linkages" (p. 5, Clark, 1989).

From doing considerable research on academic cultures, Becher (1984; 1987) found that by virtue of shared or contrasting beliefs, values, and knowledge-generating activities, disciplines could usefully be grouped into four knowledge domains -- hard-pure, hard-applied, soft-pure, and soft-applied -- that are based on two dimensions: hard-soft and pure-applied. The hard-soft dimension distinguishes hard sciences such as chemistry and engineering from soft sciences such as education, the social sciences and the humanities (Biglan, 1973a; 1973b). Hard sciences typically have a stronger consensus among members about the specific areas they will focus on and the methods for studying those areas. Soft sciences by contrast tend to have less agreement among community members about the particular area(s) to study as well as the appropriate methods to carry out research (Biglan, 1973a; 1973b; Kuhn, 1962). The pure-applied dimension distinguishes disciplines by the degree to which its practitioners concern themselves with the application of findings to practical problems. The hard sciences, the social sciences and the humanities

are less immediately concerned with applying their findings to specific problems than agriculture, engineering, and education (Biglan, 1973a; 1973b). Combining the two dimensions would yield the four domains of knowledge with the following fields as examples of each: an example of a hard-pure discipline would be chemistry; a hard-applied discipline would be engineering; a soft-pure discipline would be sociology; an example of a soft-applied discipline would be education. According to Becher (1987), graduate student "initiations" into academic work vary depending into which one of four knowledge domains a discipline fits. For example, graduate students in hard-pure fields like chemistry are more apt to work cooperatively in teams with other graduate students, a lab supervisor, and their advisor. They are likely to do research in an area already established by their advisor. They will also be more likely in experimental subjects to have their advisor or lab supervisor involved with them and their "bench" work on a regular basis, daily or weekly.

In contrast, graduate students in soft-pure disciplines such as sociology generally work in a much more independent fashion on their scientific work. "They are treated like self-employed persons or individuals of independent means" (Becher, 1987, p. 282). Besides the work and attendance requirements of their coursework, there are no "firm rules" regarding the use of time or progress toward their professional goals. Students are usually allowed to determine their own lines of research and they generally meet sporadically with their advisors. Research by Kleinman (1983) on the socialization of sociology graduate students seems to confirm this pattern. Kleinman found that early on in their doctoral programs sociology students were encouraged explicitly and implicitly by faculty and more advanced students to view themselves as individuals with distinct research and substantive interests. They were also subtly discouraged from working together on some instructional and research tasks.

Academic Departments

The academic department, the primary unit of the university, is the local incarnation of the discipline and the basic means through which the discipline sustains and regenerates itself (Becher, 1987). For Becher and Kogan (1992), the department is "especially important in the determination of professional values . . ." (p. 87). Several features of departments have proven to be important regarding the professional values graduate students acquire during socialization: department structure, climate, and mentoring (Anderson and Louis, 1991).

Department Structure. In a particularly insightful article, Van Maanen and Schein (1979) describe six different structural dimensions of organizational subunits that have an impact on the values and beliefs of "recruits" during the socialization process. Of these, four dimensions proved to be particularly important. One dimension is collective socialization versus individual socialization. Some departments, given the strictures of their discipline, will move large cohorts of students together through a common set of courses and research experiences, whereas other departments will work with students ". . . singly and in isolation from one another through a more or less unique set of experiences" (p. 233). A second dimension is formal versus informal socialization. Formal socialization involves placing graduate students in officially prescribed processes that are designed especially for the neophyte, and decidedly set the neophyte off from "full-fledged" members of the department. Informal socialization places little emphasis on the differences between newcomers and the more experienced and minimal effort is put into prescribing a separate role for neophytes. A third dimension is fixed versus variable socialization. Fixed socialization offers students "precise knowledge of the time it will take to complete" (p. 244) a portion or all of a graduate program. Variable socialization provides the students with little straight forward information about how long a program or research project might

take. Finally, an investiture versus divestiture dimension in socialization impacts the self-image or personal identity students bring with them to departments. Investiture structures affirm and support the student for who they are. Divestiture structures work to remove or suppress the student's entering identity.

Research by Anderson and Louis (1991) appears to support the importance of these structural dimensions for influencing the values students acquire during their graduate experience. Anderson and Louis looked at the influence of these same department structural variables on whether graduate students (from microbiology, chemistry, sociology, and civil engineering) subscribed to values useful to the promotion of good science and technology or values contrary to the interests of science and technology. Their findings indicated that departments with formal and collective structures for socializing students were positively correlated with students subscribing to values contrary to the interests of science and technology. They argue that:

> impersonal, routinized graduate programs in which students work together in large "batches" on research projects, may foster a tendency to subscribe to counternorm standards. These students may simply not have the close one-to-one relationship with a scientist or engineer which is presumed to provide appropriate socialization into the field. (p. 18)

Department Climate. Another aspect of an academic department thought to influence the values of graduate students during their socialization is climate. The climate of a department or organization has long been found by researchers to effect the activities and attitudes of department members (Pritchard and Karasick, 1973). Climate generally refers to the presence or absence of trust between individuals and/or groups, the level of competitiveness or cooperation, "mutual support or parochialism, [and] open or closed

communication" (p. 13). In addition to these factors, Victor and Cullen (1987) have suggested that a department's climate can also have ethical dimensions. These dimensions are institutionalized normative systems that guide individuals in handling "practices and procedures with ethical consequences" (p. 103), in other words, actions or decisions that would impact other department members and/or the conduct of science. Anderson and Louis (1991) found support for Victor and Cullen's work. Their results suggested that graduate students in a department with professional values congruent with their student peers were more likely to support norms helpful to the promotion of an ethical orientation.

Methods

Data Collection

The data presented in this paper are based on a survey of 2000 graduate students in research universities, conducted in the fall of 1990 in cooperation with the Acadia Institute's Project on Professional Values and Ethical Issues in the Graduate Education of Scientists and Engineers. Our selection of academic disciplines was grounded in part on Biglan's (1973a, 1973b) typology of academic departments, which delineates three dimensions of the knowledge base for the discipline: pure versus applied, hard paradigm versus soft paradigm (in the sense of Kuhn, 1970), and life versus non-life fields. We chose to emphasize distinctions among various combinations of pure/applied and hard/soft-paradigm profiles. We therefore chose two fields from the pure/hard-paradigm group (microbiology and chemistry), one applied/hard-paradigm field (civil engineering), and one pure/soft-paradigm field (sociology).

Another criterion for our selection of particular fields within Biglan categories was the extent of graduate education in those fields: we chose disciplines in which substantial numbers of doctoral

degrees are currently being awarded. There exists no comprehensive list of graduate students in any of the sampled disciplines, and lists therefore needed to be generated by contacting departments directly. In order to simplify the development of lists of graduate student names from which to sample, the largest departments in these four disciplines were sampled, based on data for the period July 1985 to June 1988 from the Directory of Graduate Programs: 1990 & 1991, produced by the Graduate Record Examinations Board and the Council of Graduate Schools in the United States.

The selection of the largest producers of graduate students was not only practical, but relevant to the overall objectives of the project, which included examining the effects of specific department climates on students. Given the large size of many chemistry departments, only those departments which awarded 50 or more Ph.D.'s during this period were selected. For the other disciplines, departments which awarded at least 20 Ph.D.'s during this period were chosen. This procedure yielded 98 departments.

Next, chairs of these departments were contacted by mail, and asked to provide the names and addresses of doctoral students who were currently enrolled full-time in their departments. As the survey was to be sent out during the fall term, we requested that first-year doctoral students be removed from the lists, on the assumption that these students would not yet be familiar enough with graduate study to provide informed responses. All but two of the department chairs (one in microbiology and one in sociology) complied with the request. From the student lists provided by departments, a random sample stratified by discipline was selected. The resulting sample consisted of 500 students from each of the four selected disciplines.

The questionnaire sent to the students in the sample included a wide variety of items relating to graduate education. We asked the students about, among other things, their doctoral programs, their academic and social experiences in their departments, their mentors, and their experiences

with ethical issues and research misconduct. The items on the questionnaire that are relevant to this analysis were based on theoretical perspectives provided by Merton (1957) on norms of research, Mitroff (1974) on counternorms of research, Victor and Cullen (1988) on ethical climates, and Van Maanen and Schein (1979) on socialization. The questionnaire was pretested on groups of students in the sciences, social sciences, and engineering. Pretests involved administering the questionnaire to a small group of students, and then discussing with them issues of difficulty, problems of interpretations, etc. Special effort was made to include foreign graduate students in the pretests to ensure that the questionnaire was easily understood and appropriately interpreted by non-native English speakers. The questionnaires were tailored to each field, where appropriate. Chemists and microbiologists received questionnaires referring to "scientists", whereas civil engineers and sociologists received questionnaires referring to "engineers" and "social scientists", respectively.

The questionnaires were mailed in November, 1990. They were coded by discipline and by institution, but not by individual respondent. The sensitive nature of some of the items on the survey made it imperative to ensure respondents' confidentiality; consequently, each questionnaire packet contained a separate postcard by which the student could notify us that he or she had returned the questionnaire, without having that information linked in any way to the questionnaire itself. Two weeks after the initial mailing, reminder postcards were sent out, and after three more weeks, a second set of complete questionnaire packets were sent to non-respondents. The follow-up procedures produced an overall response rate of 74 percent. The adjusted response rate was 72 percent. By discipline, the overall response rates were: chemistry, 74 percent; civil engineering, 61 percent; microbiology, 73 percent; and sociology, 70 percent.

Definition of Variables

The focal variable for this analysis is academic misconduct. We asked students to report their own experiences with a broad array of misconduct behaviors on the part of doctoral peers and faculty in their departments. The relevant items from the questionnaire are presented in Appendix 1. We specified that we wised to know about instances of misconduct that the students had observed or had other direct evidence of, within their doctoral programs. For each of 13 kinds of misconduct, students indicated the number of students and, separately, the number of faculty whom they had observed engaging in the given misconduct. Responses were coded as: None (0), 1-2 (1), 3-5 (2), and More Than 5 (3). Since one form of misconduct was not appropriate for faculty (cheating in coursework), there were 12 faculty items, 13 student items, each ranging from 0 to 3. We then created the composite variable, overall misconduct, by summing these 25 items. The overall misconduct scale, therefore, has a potential range from 0 to 75.

We also consider separately three categories of misconduct. Research misconduct refers to behaviors that violate the norms and standards specific to the academic enterprise. Employment misconduct includes conduct that would be deemed inappropriate or illegal in most organizations, even outside the academic world. Personal misconduct refers to inappropriate or illegal behaviors among individuals, again with reference to the broader social context. The specific items assigned to these three misconduct types are listed in Appendix 1.

The independent variables at the individual level are gender, citizenship status, and years in the graduate program. For this analysis, gender and citizenship status are included as dummy variables with a value of 1 for female and international students, respectively. The third independent variable is the number of years the student has been in his or her graduate program. The sampling procedure ensured that each respondent had been in his or her department for at least one year.

At the department level, the independent variables relate to departmental structure and climate, and associated academic discipline. We used factor analysis in the construction of relevant scales at this level. In the climate case, a principal components factor analysis, with varimax rotation, was used with the preidentified set of climate-related items. The analysis produced eight factors. For two factors that loaded highly on several variables (humane and competitive environments), scales were computed as a sum, with unit weights, of the set of variables identified as loading heavily on a given factor. The reliability coefficients for these scales are presented in Appendix 2. The remaining factors consisted of two or three variables which were not highly correlated. In these cases a single indicator variable with a non-skewed distribution was selected to represent the underlying construct that most closely related to discussion of ethical climates presented in Victor and Cullen (1987). The structure variables were constructed in the same way. The components of the indicators and their associated reliabilities are presented in Appendix 2. The structure and climate variables were aggregated to the department level, with each department assigned its mean for each variable.

At the department level, academic discipline is represented by dummy variables, where the chemistry variable takes on the value 1 for chemistry departments, and so on for the other disciplines.

Analytical Approach

We first present descriptive analyses, along with appropriate tests for disciplinary differences. We then use a hierarchical linear model to investigate the effects of discipline and department structure and climate on student reports of misconduct. This approach permits us to analyze department-level effects, while controlling appropriately and simultaneously for individual characteristics such as gender and citizenship status.

Descriptive Results

Table 1 presents basic descriptive statistics for the variables used in this analysis. As indicated above, this study is based on the 1261 respondents from the 73 departments having at least nine respondents. On average, each department has 17.27 respondents, with averages across disciplines ranging from 14.86 in chemistry to 20.71 in microbiology.

[INSERT TABLE 1 ABOUT HERE]

Overall, just over one-third (34.3 percent) of the respondents are international graduate students. There are, however, significant differences across disciplines in the proportions of international students ($X^2 = 94.104$; $p < .001$). In civil engineering, nearly 60 percent are not U.S. citizens, whereas in chemistry and microbiology, approximately half that proportion are international students. Fewer than one-quarter of the sociology students are internationals. According to the Biglan typology, which we used to guide our selection of disciplines, civil engineering is applied/hard-paradigm, suggesting that developing countries would have an interest in the technology produced in this field as well as the opportunity to benefit from well-established patterns of disciplinary instruction and investigation. Chemistry and microbiology, both being pure/hard-paradigm, do not have the advantage of an applied orientation, from the standpoint of international students. They do benefit from their well-developed paradigms in attracting students from abroad, since disciplinary patterns are more likely to be shared across national boundaries. By the same reasoning, sociology, being neither applied nor hard-paradigm, is the least likely to attract international students.

There are also significant differences in the proportions of women in the fields considered (X^2 = 126.759; $p < .001$). Overall, 36.9 percent of the respondents are women, with the highest proportions being in sociology (55.1 percent) and in microbiology (45.4 percent). Given the well-documented problems in engineering of recruiting and retaining female students, it is not surprising that civil engineering has the lowest proportion of women (13.9 percent).

The students represented in this analysis have been in their present graduate programs for an average of 2.94 years. (First-year students were omitted from the sample). Disciplinary averages range from 2.63 years for civil engineering to 3.48 years for sociology. The differences in these means (which are significant: $F = 13.097$; $p < .001$), not only correspond to the hard versus soft paradigm distinction made in the Biglan typology, but also correspond generally to the differences in time-to-degree documented by Bowen and Rudenstine (1992, p. 132).

The measures of misconduct all vary across disciplines; the variation is highly significant for overall misconduct and for the categories of employment and personal misconduct ($p < .001$, in each case), but only marginal for research misconduct ($p < .09$). Overall misconduct is highest in chemistry and in sociology, while research misconduct is highest in chemistry. Employment misconduct is highest in chemistry and microbiology, and personal misconduct is highest in sociology, with a relatively high level in chemistry as well. All of the misconduct scores have rather high standard deviations at the individual level, within disciplines.

Overall reported misconduct is highest in chemistry and sociology, and lowest in civil engineering. In chemistry, high scores in research and employment misconduct contribute to the overall misconduct level. In sociology, relatively low scores in these two types of misconduct are offset by a high score in personal misconduct. The level of reported personal misconduct in sociology is likely related to the items on sexual harassment and discrimination included in this scale, the skewed distribution of responses to these items by gender, and the high proportion of women in

sociology. However, it is intriguing to note that microbiology is relatively low in reported personal conduct, even though it also has high proportions of female students, suggesting disciplinary differences in patterns of sexual harassment and discrimination. Civil engineering is not only lowest in reports of overall misconduct, but has the lowest mean scores for each of the subcategories of misconduct. The relationships among measures of misconduct and discipline are explored in greater depth in subsequent sections.

Table 2 presents the correlation coefficients, at the level of individual students, for all the variables used in this study. The various forms of misconduct are all highly correlated with each other and, quite naturally, with the overall measure of misconduct. The individual-level independent variables (years in the program, the dummy variable for international students, and the dummy variable for female students) all have consistent correlational patterns across the various forms of misconduct. Years is consistently positively correlated with misconduct, presumably reflecting the likelihood that students who have been around longer have had more opportunities to observe misconduct.

[INSERT TABLE 2 ABOUT HERE]

International student status is negatively correlated with misconduct in all its forms. While this relationship is consistent with our earlier findings that international students and their U.S. peers tend to subscribe to different sets of scientific norms (Anderson and Louis, 1991; Louis and Anderson, 1992), it may also reflect lower levels of integration into departmental activity, or less certainty about the interpretation of behavior as misconduct. That is, students may not witness as much misconduct; or if they do observe the same levels of misconduct, they may either not consider the behavior as inappropriate or they may be ambivalent as to the degree of impropriety involved.

Female graduate students tend to report higher levels of misconduct than their male counterparts, though the difference is significant only in the cases of personal and overall misconduct, where the former significant difference probably produces the latter. Again, we attribute women's greater likelihood of having experienced personal misconduct to the items on sexual harassment and discrimination, for which responses are highly skewed by gender.

Correlational patterns between the discipline variables and the misconduct and student-characteristic variables support the related conclusions presented above.

The departmental structure and climate variables are used in subsequent analyses at the group-mean level; however, their individual-level counterparts, appearing in the correlation matrix, reveal some interesting patterns. Higher levels of misconduct, of all kinds, are associated with departments that are competitive and exploitative, that require students to divest themselves of their values and feelings of self-worth, and that value individual over collaborative research. Lower levels of all forms of misconduct are reported in departments in which students receive good feedback on their work, regulation is less formal, graduate students are encouraged to be self-directed, faculty and students treat each other more humanely, students sense that their peers share their own professional values, and students and faculty collaborate on publications. In the case of personal misconduct, levels of reported misconduct tend to be lower when students work with others (collaborate, work in larger groups, and have more contact with other students). This finding contradicts the assumption that students who have more contact with other people have more opportunities to observe misconduct and thus will report higher levels of misconduct. It is unclear whether collaborative groups actually produce less inappropriate behavior, whether people in larger working groups tend not to see inappropriate actions as misconduct, or whether individuals who tend not to label certain actions as misconduct are more likely to be found in larger working groups.

A partial explanation for the different levels of personal misconduct reported by students in microbiology and sociology, despite the presence of high proportions of female students in each field, is provided by an interpretation of the correlations between these fields and the departmental structure and climate variables. Out of the 16 departmental variables, 13 have opposite-sign correlations for microbiology and sociology students. In contrast to their sociology counterparts, students in microbiology receive good feedback, are formally regulated, work and publish collaboratively, work in large groups, are not encouraged to be self-directed, share professional values with their peers, and find their departments to be humane and less competitive. While this description contradicts, in part, the list of factors associated with low levels of misconduct (and there is no reason it should not), it nonetheless underscores the differences in microbiology and sociology programs as experienced by their students, and may account for some of the difference in reported personal misconduct between these fields.

Further exploration of the effects of the department-level variables is central to the hierarchical linear analyses presented below. The main result of the high correlations among these scales themselves, and between discipline variables and department scales, is that, in the hierarchical analyses, all of these scales need to be investigated for unique effects, to avoid problems of multicollinearity.

Analytic Results

The focus of our investigation is on departmental and disciplinary effects on reported levels of misconduct. There are, however, a number of individual-level variables (gender, citizenship status, length of time spent in a department) that, as noted above, are likely to influence the level of misconduct that a student observes. Hence, our aim is to examine the relationship between department-level variables and individual misconduct-report scores, controlling for differences among individuals. This approach leads naturally to a hierarchical structure for the model to be estimated.

Hierarchical linear modelling (HLM) express relationships among variables at different levels of analysis. In the present case, we express an individual's misconduct score as a function of gender, citizenship status, and number of years in the graduate program, on the assumption that these variables affect the degree to which a student is likely to have direct experience with misconduct on the part of students or faculty in his or her program. The individual-level equation resembles an ordinary regression equation:

$$\text{Misconduct} = B_0 + B_1(\text{Years in Program}) + B_2(\text{International}) + B_3(\text{Female}) + R.$$

Here, misconduct may be research, employment, personal, or overall misconduct. We use deviations from the mean for the variable "years", as this makes interpretation of the parameter estimates easier, as shown below. Since this equation is at the level of individual respondents, there is one such equation for each person in the sample (1261, assuming no missing data on relevant variables). The error term, R, represents variation at the individual level.

The model's department-level equations express the B_i parameters of the individual-level equations as functions of department-level variables:

$$B_0 = C_{00} + C_{01}(\text{Department Variable 1}) + \ldots + C_{0k}(\text{Department Variable k}) + U_0$$

$$B_1 = C_{10} + C_{11}(\text{Department Variable 1}) + \ldots + C_{1k}(\text{Department Variable k}) + U_1$$

$$B_2 = C_{20} + C_{21}(\text{Department Variable 1}) + \ldots + C_{2k}(\text{Department Variable k}) + U_2$$

$$B_3 = C_{30} + C_{31}(\text{Department Variable 1}) + \ldots + C_{3k}(\text{Department Variable k}) + U_3.$$

These equations express the effects of department-level variables on the relationship between reported misconduct and the individual-level variables, since this relationship is represented by the B coefficients. The department variables here include the dummy variables for discipline (omitting sociology, thereby using it as the basis for comparison), and the departmental means on the structure and climate scales. There is one set of department-level equations for each department under consideration (73 departments), and the U error terms represent department-level variation.

In this form, the parameters of the hierarchical model can be estimated by a algorithm developed by Bryk and Raudenbusch (1991). The advantage of their algorithm is that the parameters at both levels can be estimated simultaneously by an iterative procedure, assigning variance to the individual or department level as appropriate. It is then possible to avoid both errors due to aggregation at the department level and errors due to imputation at the individual level. What is more, the procedure produces the accurate estimates of variance necessary for testing hypotheses about the significance of the parameter estimates.

While it is technically possible to estimate the full model presented above, it is inappropriate to do so without doing diagnostic analyses to determine how the individual- and department-level variables should be related. For example, in the present case, the four measures of misconduct turn out to require different configurations of the other variables. We therefore follow a four-step procedure for determining the appropriate forms of the model for the four dependent variables.

Step 1.

The first step involves verifying that the dependent variable (misconduct) varies significantly across the group-level units (departments). If it did not, there would be no point in trying to assign explanatory power to department characteristics. This step can be accomplished by estimating a reduced model in which $B_i = 0$ for $i > 0$, and $C_{0j} = 0$ for $j > 0$. This estimation step is equivalent to a one-way analysis of variance on the dependent variable (misconduct), across departments. We actually did this diagnostic step through HLM, and found significant differences across departments for all the misconduct variables. Here, however, we present the results of a simple anova in Table 3, together with the associated means and standard deviations of the misconduct measures. All four measures of misconduct vary significantly ($p < .001$) across departments. Table 3 also presents the results of analyses of variance for the departmental structure and climate variables. Since all of these also vary significantly across departments, we proceed on the assumption that department-level variance in structure and climate may prove to explain variance in observed misconduct.

[INSERT TABLE 3 ABOUT HERE]

Step 2.

The next step involves estimating the effects of department-level variables (structure, climate, and discipline) on the mean level of observed misconduct in a department. This estimation is accomplished by setting $B_i = 0$ for $i > 0$. (The reduced model is presented in Table 4). The remaining parameter in the individual-level equation, B_0, represents the mean misconduct score at the department level, which is expressed as a function of the structure, climate, and discipline variables. Table 4 presents the parameter estimates for each of the four misconduct variables. Here, effects of structure, climate, and discipline variables were estimated separately, to illustrate distinct effects within these variable sets. Only parameters with significant effects are displayed. (In untabled analyses, all of the structure and climate scales, as well as the discipline variables, were entered into the hierarchical linear model individually, to counteract the effects of potential collinearity. The results corresponded exactly to the findings as presented in Table 4.)

[INSERT TABLE 4 ABOUT HERE]

The only structural variable to have an effect on a department's mean level of misconduct is the size of working groups in the department, and it is significant only in the case of employment misconduct. The positive coefficient indicates that departments in which students work with relatively large groups of researchers and other students tend to have higher mean levels of reported employment misconduct. This finding is only weakly supported by subsequent analyses. Climate variables show no significant effects at all on mean levels of misconduct, of any type.

Discipline has more prominent effects on average levels of misconduct. Since the dummy variable for sociology is omitted, the significance of disciplinary effects in this category lies in their deviation from sociology's effects. Civil engineering has a negative effect on overall misconduct. It is apparent that this effect is due primarily to the great difference between reported levels of

personal misconduct in civil engineering and sociology departments. Both chemistry and microbiology also have significant, negative effects on personal misconduct. This finding echoes the related descriptive results above, where a gender-based explanation is complicated by the fact that both sociology and microbiology have high proportions of female students. In the case of employment misconduct, both chemistry and microbiology have significantly higher levels of mean misconduct than sociology.

Step 3.

Few of the department-level variables proved significantly related to mean levels of misconduct in departments at Step 2. This may be due, in part, to the fact that we have not controlled for characteristics of individuals that may affect observations of misconduct. Gender, international student status, and number of years in the program are all significantly correlated, at the individual level, to one or more of the measures of misconduct (see Table 2). In Step 3, therefore, we determine what form the individual-level equations should take to control appropriately for these individual characteristics. To do so, we use the individual-level equation from the full model, with $C_{ij} = 0$ for all $j \geq 0$ and for all i. We present the reduced model in Table 5.

[INSERT TABLE 5 ABOUT HERE]

For each individual-level variable, there are two diagnostic questions to ask in deciding how the variable should enter the model. First, the variable may or may not have an overall effect on the dependent variable, misconduct. Second, even if a variable has a significant overall effect, that effect may or may not vary across the group-level units (departments).

Table 5 presents the significant effects of individual-level variables on reported misconduct. Years in the graduate program has a significant overall effect for every measure of misconduct, indicating

that it should be retained in the model for all forms of misconduct. The positive sign of the parameter estimate indicates that the longer a student is in a program, the higher his or her level of observed misconduct. Since the estimated parameter variance across departments for the years variable is also significant, we assume that the years-misconduct relationship may vary by department or discipline characteristics. Therefore, we express years as a function of the department-level variables in the model.

$$B_1 = C_{10} + C_{11}(\text{Department Variable 1}) + \ldots + C_{1k}(\text{Department Variable k}) + U_1$$

The dummy variable for international-student status proves at least marginally significant for all forms of misconduct. (The negative value of the parameter estimate indicates that international students are less likely to report high levels of observed misconduct in their departments). We include the international variable in the model for each for each misconduct type, on the assumption that even marginal effects are worth pursuing at this stage. The variable's effect, however, varies significantly across departments only in the cases of research and personal misconduct, and only marginally in the former case. For research and personal misconduct, the international variable is expressed as a function of the department-level variables,

$$B_2 = C_{20} + C_{21}(\text{Department Variable 1}) + \ldots + C_{2k}(\text{Department Variable k}) + U_2$$

but in the overall and employment misconduct cases, we include it as a fixed effect (with zero variance across departments),

$$B_2 = C_{20}.$$

The dummy variable for female students has no overall, significant effect, except in the personal misconduct case. Here, there is a significant, positive effect, indicating that female students report

higher levels of observed misconduct in this area. The effect, however, does not vary across departments, and therefore is included in the personal misconduct model as a fixed effect with zero variance:

$$B_3 = C_{30}.$$

The constant term in the individual-level equation, B_0, also may or may not vary across departments. In Step 2, above, this term was interpreted as the mean level of misconduct in a department. Here, however, the constant term has a different interpretation, depending on what individual-level variables are included in the model. The general principle is that the constant term represents the mean level of the dependent variable (misconduct) for the group of individuals defined by setting the independent variables equal to zero. Thus, for overall, research, and employment misconduct, the constant term represents the average level of reported misconduct for U.S. students whose length of time in their programs matches equals the mean time-in-program for the entire sample. In the personal misconduct case, since we have included the dummy variable for female students, the constant term must be interpreted as the mean reported misconduct for male, U.S. students who have been their programs an average length of time.

As Table 5 shows, the base (constant) coefficient not only has a significant effect for every form of misconduct, but the effect varies significantly across departments in every case. We thus include the constant term as a function of the department-level variables:

$$B_0 = C_{00} + C_{01}(\text{Department Variable 1}) + \ldots + C_{0k}(\text{Department Variable k}) + U_0$$

Step 4.

The models derived in Step 3 for the various forms of misconduct are presented in Table 6. The final step involves estimating department-level effects (structure, climate, and discipline) on misconduct, while controlling for individual-level variables. Table 7 presents the results of full-model analyses for structure, climate, and discipline effects separately. It also presents analyses that incorporate only the variables that proved significant in the separate analyses, in effect permitting the strongest structure, climate, and discipline variables to compete.

[INSERT TABLES 6 AND 7 ABOUT HERE]

For the most part, the independent effects of individual-level variables on average level of reported misconduct, expressed by the coefficients C_{10}, C_{20}, and C_{30}, correspond to the effects produced in Step 3. Years-in-program has significant positive effects on misconduct in the discipline models, as expected. It has an unexpectedly negative effect on employment misconduct in the climate model, which persists even when the significant structure and discipline variables are added in the final analysis. It may be that students who observe a great deal of misconduct in this area, which encompasses forms of misconduct that would be inappropriate in any work context, do not continue in the program.

The international variable has anticipated independent effects on reported misconduct, with one marginally significant exception. International students report lower levels of misconduct than their U.S. peers, particularly in the areas of overall and employment misconduct. Since the items in the employment scale refer to research policies and use of funds, it may be that international students are simply less aware of formal standards for the conduct of research in the U.S. and regulations governing the appropriate expenditure of institutional and research dollars. The one

exception to the pattern of international effects is in the case of personal misconduct, in the structure analysis, but the positive effect here is only marginally significant.

As expected, the female variable has significant, positive effects on mean reported personal misconduct. (As explained above, the mean in this case is computed for male, U.S. students with average time-in-program.) The positive sign of the parameter estimates indicates again that female students report higher levels of observed personal misconduct.

Turning now to the separate analyses, we consider first the effects of departmental structure. Structured feedback, which includes helpful evaluation and attention from a faculty member, has a negative effect on reports of employment misconduct for the reference group, U.S. students with average time-in-program. This finding suggests that in departments where students get adequate attention, they also see their peers and professors handling research ethics and financial affairs in appropriate ways. The alternative explanation, that in departments that pay adequate attention to students, the students do not have as many opportunities to observe misconduct in this area, appears unlikely. Feedback also has negative effects on the relationship between years and misconduct. That is, in departments that provide good feedback, being in the program for a long time is less likely to produce high levels of observed misconduct, particularly in the case of research misconduct.

Collaboration has a significant, negative effect on mean levels of observed personal misconduct. The reference group here, U.S. males, thus reports fewer instances of personal misconduct in departments where students tend to work on collaborative projects.

Size of work group affects the years-misconduct relationship. When a department's students tend to work in large groups, the students report more instances of misconduct, employment and overall, the longer they have been in their programs. The simplest explanation may be that such

students simply have more opportunities to observe their peers and faculty dealing with research policies and funding, and therefore uncover more questionable practices. This explanation, however, rests on the troubling assumption that employment misconduct (for instance) is generally distributed through academic departments, so that greater exposure to others in the work environment implies more actual observation of misconduct.

Divestiture, the student's experience of losing part of his or her previous sense of self, has a positive, but marginal effect on personal misconduct. This effect, however, attains greater significance in the final model, which adds climate and discipline variables.

The second analysis in Step 4 focuses on climate variables. A competitive climate has positive effects on both mean levels of reported misconduct and the years-misconduct relationship, for all forms of misconduct except research misconduct. In a department where students must compete for resources and faculty attention, there are most instances of reported misconduct, and the longer students stay in the program, the more likely it is that they will witness misconduct.

Student-faculty collaboration on publications is also associated with higher levels of misconduct, primarily employment misconduct. It appears that this form of misconduct captures the details of academic work, in terms of research conduct, funding, and distribution of effort, and that the close working relationship implied in collaboration reveals more instances of misconduct in this area.

By contrast, a climate in which students tend to feel that their graduate assistant obligations are delaying their academic progress tends to have a negative effect on the years/misconduct relationship. When obligations interfere with progress, students who are around longer are not as apt to see misconduct (overall, employment, or personal). In these departments, such obligations may effectively buffer students from exposure to work contexts in which other students tend to

observe misconduct. The very obligations that keep them from progressing may also keep them from knowing either appropriate standards or how their peers and professors deal with their work..

A sense of solidarity with students' entering cohort has a positive effect on observed instances of personal misconduct. In such cases, an "us-them" perspective may raise students' awareness of violations in personal interrelationships.

The final climate effect is more problematic to interpret. Individualism, the valuing of individual over collaborative research, has the same positive effects, though marginal, on the years-misconduct relationship as collaborative publishing. It also has a negative effect on the international-misconduct relationship. That is, in departments that value individual work, international students are even less likely to observe personal misconduct, presumably because they have less interaction with others in their work.

The third analysis employs the dummy variables for discipline, using sociology as the standard for comparison discipline. In all of the other disciplines, students in the reference group (U.S. males with average time-in-program) report significantly lower levels of personal misconduct. We infer that students in this group see more harassment, discrimination, and exploitation that their peers in other fields. Interestingly, however, students in chemistry and microbiology report more instances of employment misconduct.

International students, overall, tend to report lower levels of personal misconduct than their U.S. peers. This effect, however, is tempered in microbiology departments, since the microbiology dummy variable has a positive effect on the international-personal misconduct relationship.

Table 8 presents the results of the final analyses of Step 4. Here we include in the HLM models all of the variables that proved significant or marginally significant ($p < .08$) in the separate structure,

climate, and discipline analyses. Consequently, different sets of department-level variables were used, not only for different types of misconduct, but also in association with different individual-level variables.

[INSERT TABLE 8 ABOUT HERE]

The main result of the combined analysis is that the climate variables are more likely to retain their significance than either the structure or discipline variables. Omitting marginal effects for this final analysis, of the 16 climate effects presented in Table 8, 13 are significant at the .05 level or better. By contrast, only 3 of 8 structure effects, and only 2 of 6 discipline effects, are significant. The one structure effect that appears particularly robust in competition with the climate effects is structured feedback.

The Theoretical Framework Revisited

At the beginning of this paper we pointed to a number of domains that may jointly determine the environment for graduate student socialization. There is a broad social context, in which larger social norms are brought to bear on the behavior of academics and students. Then there are the more proximate social contexts, including the multiple institutions that regulate science within the academy (university, federal government, etc.), the specific disciplines and their norms and expectations, and the department, which is the active environment that graduate students encounter on a day-to-day basis. In this paper we have attempted to look at the way in which these affect the experiences of students.

The findings presented above are complicated. But, there are a number of generalizations and tentative conclusions that rise above the mass of individual coefficients. These suggest that there are key tensions in the socialization of graduate students that should be given clearer focus within the university.

We begin from two premises in socialization theory. First, graduate students should be exposed to socialization settings that are viewed as effective in transmitting not only the technical skills, but also the norms of scientific conduct. In addition, such contexts should support the broader social expectations about what constitutes appropriate professional behavior, not only for scientists but for others in positions of influence. Second, students should not be exposed to misconduct, since such exposure (aside from its other implications) is likely, at minimum, to make students cynical, but may also encourage them to believe that misconduct is all right -- part of the "way things are," and thus undermine efforts to transmit the social expectations of society, the institutional context and the discipline. While the broader contexts can have an indirect effect on the students' experiences with misconduct, for most graduate students the basis for experience lies with those with whom they interact on a daily basis: their peers and their professors.

Exposure to Misconduct

Our descriptive findings concerning the incidence and exposure of graduate students to misconduct should not be lost among the more complex analyses. Today's graduate students, irrespective of their discipline, encounter misconduct on a regular basis over their graduate student careers. The data fail to support the often-expressed assumption that highly publicized misconduct issues that are highlighted in the national press represent a very small number of incidents, and that most problems with faculty and student conduct are adequately uncovered and handled through existing oversight and grievance

procedures. The typical graduate student in this study has been exposed to between two and five instances of misconduct in each of our three categories, including misconduct both by fellow students and by faculty members. The three forms of misconduct are highly correlated -- particularly research misconduct and employment misconduct -- so we may assume that students are either being exposed to many instances, or that they have experienced a few incidents in which multiple forms of misconduct are interrelated.

Students are unlikely to report these instances, since they are concerned about retribution for whistle-blowing (not tabled). Furthermore, relatively few students believe that their departments are adequately preparing them for the ethical issues that they will face in their future careers (not tabled). We conclude that, between the high levels of exposure, and the absence of opportunities to discuss these issues openly, students are being socialized in an environment that must create ambivalence about the basic norms of the academy; namely the obligation of the scholarly community to uphold the highest standards of scientific behavior, and to enforce the norms of the broader society regarding the behavior of professional employees.

Research Misconduct

There is "good news" in this study for those who argue that research misconduct is not a systemic problem for graduate education--or for science in general. Although the rate of faculty research misconduct observed by students is as high as other forms of misconduct, there is no evidence that there are specific department or disciplinary characteristics that are associated with misconduct. In other words, those who argue that fraud, "data doctoring" and plagiarism are the results of random, individual predilections or failures of judgment that may be controlled through institutional oversight and peer review, but that cannot

easily be prevented by restructuring or reorganizing departments could find some comfort from these data. Our findings thus support the "bad apple" theory.

The implications for graduate education are not clearcut, but there seem to be two possible interpretations. First, we might assume that, if research misconduct is random and not associated with other system characteristics, students will find it easier both to identify it (because it contrasts with other behavior around them) and to reject it. Alternatively, one might argue that because research misconduct does vary between departments, but not between disciplines, that we have simply failed to measure the important department characteristics (for example, the rigor of peer review within the department or the university) that account for such behavior. Some graduate students are still being exposed to more misconduct than others, and further research is needed to determine how this may be better controlled.

Personal and Employment Misconduct

There is also considerable reason to be less sanguine, particularly if we are concerned about a broader value-base for the academic enterprise. In science there is an ingrained assumption that working closely "at the bench" with professors and more advanced or post-doctoral students will expose graduate trainees to the needed techniques and values that will sustain them throughout their career. Yet, we find in this analysis that collaboration and exposure to other scientists-at-work is a two-edged sword. On the one hand, the graduate students in our sample who worked on collaborative projects were less likely to be exposed to some forms of humiliating misconduct--sexism, racism, and other forms of interpersonal exploitation. Presumably the presence of others inhibits those who might otherwise indulge themselves in forms of personal exploitation. On the other hand, students who work in collaborative settings, who have relationships that are close enough

to result in co-authoring papers, and who have opportunities to see many other students and professors at work are more likely to encounter conflict of interest, commitment and down-right white collar crime. This suggests that in those contexts where the availability of research funding permits larger-scale endeavors in which students actually see faculty at work, students are likely to notice that faculty do not measure up to typical university policies and social expectations.

The disturbing conclusion is that students who have the best opportunities to learn the skills needed to conduct scientific work are also those who are most likely to be exposed to --- and presumably accept or at least become innured to --- forms of behavior that are increasingly viewed as either illegal or against university policy. This does not imply that scientists are more culpable than other trusted individuals: the finding that professionals-in-training exhibit increasing levels of cynicism and "hardening" is hardly new (Merton, 19XX). However, it does suggest a clear dilemma in the structuring of socialization settings.

The Disciplinary Context

At the descriptive level there are important differences between disciplines, with chemistry students more likely to be exposed to research and employment misconduct, while sociology students are more likely to be exposed to personal misconduct. These disciplinary differences disappear in the case of research misconduct in our full analysis, when we control for the characteristics of departments.

Again, this finding may comfort some, who argue that the life/health sciences have been unfairly treated by the media, because the types of research misconduct that occur in these fields are so newsworthy. On the other hand, the data for employment and personal

misconduct sustain the finding of disciplinary effects, albeit at a rather low level. We do not, of course, know why the climate of some disciplines has encouraged (or not punished) different forms of misconduct. Yet, the findings suggest (and we would strongly argue) that the disciplines, as well as the institutions, must attend to the variety of ways in which graduate students may be exposed to problematic behavior. Typically disciplines have raised misconduct issues at the level of high rhetoric, affirming general principles while not addressing ways in which disciplinary-specific characteristics may promote or undermine various types of misconduct along the lines identified in this research.

So long as we limit our discussion of misconduct to research fraud (with which university policies are typically concerned), and relegate all other forms of misconduct to "other problems", we will not engage the disciplines in a more systematic discussion of issues of professional conduct. These are widely believed to be part of the general debate over conduct in the medical profession (although they were, until the advent of the federal government as an institutional actor, largely ignored). They should, in our view, be so within the academic professions as well: Although we have no patients, we deal with vulnerable clients of our expertise who have few resources with which to confront our misbehavior.

Particularly suggestive is the contrast between microbiology and sociology. Both are female dominated fields (in terms of the proportion of graduate students), yet they fare very differently in terms of personal misconduct. The issue of gender is highlighted by this study, since one field, sociology, stood out among the four as characterized by perceived problems among female students even when controlling for the characteristics of departments. Since we have only two disciplines with a large number of women, we cannot generalize further. The results, however, suggest that interpersonal misconduct is an area that deserves considerably more attention, by discipline, than it has received.

The Department

The results suggest rather strongly that the climate and structure of socialization settings as they are enacted at the department level are critical. The main implications have been discussed above under the context of employment and personal misconduct, and in the text. We would like, however, to summarize the implications: where departments pay significant attention to students (by no means all departments) they also increase their influence. This may be positive (helping students to collaborate on papers) or negative (giving them more opportunities to observe misconduct). In contrast, where departments ignore students' needs (largely where teaching and research assistant obligations are not integrated with degree program requirements), students are too remote from professors and peers to be involved in the "underside" of the scientific enterprise.

Can departments have it both ways? Of course, and our data suggest some approaches for the design of graduate programs. First "batch processing" involving larger workgroups seems (not surprisingly) to increase opportunities to observe possible misconduct--but, we would surmise, without necessarily providing more opportunities or a supportive environment in which to discuss and resolve ambivalences about conduct. Large projects where there are many graduate students, many post-doctoral students, and few professors around may also reflect (or breed) competition for attention among graduate students and "publish or perish" among professors (other department characteristics strongly associated with observed misconduct of all types). The problematic nature of a competitive environment is further reflected in the powerful impacts of individualism--or "people out for themselves".

Are these conditions alterable? We would argue that, to a great extent, they are. Professorial oversight of doctoral students may conflict with the entrepreneurial tendencies of the modern "multiversity," but conflicts can be adjudicated and minimized if they are recognized and discussed. Insofar as the status quo is simply accepted as a necessity, issues related to the design of graduate programs at the department level will remain in the background. In particular, the observation that climate (a highly modifiable variable) is more important than structure (more difficult to change in the short run) suggests that there are things that departments can do to affect the context for graduate education in a relatively short period of time. It then may be able to make long-term changes in the degree to which misconduct --- particularly employment and personal misconduct, which appear to be more sensitive to organizational characteristics --- is a factor in the department.

Summary

Attacking misconduct per se without attending to the conditions that promote it is likely to achieve as little as bemoaning the state of the economy without a solid basis for intervention. Our analysis, albeit exploratory, has revealed that the most localized contexts in which graduate students live --- the discipline and the department --- have a great impact on their exposure to misconduct, which we have defined as a profound socialization experience. We must not discount the individual experience, nor the impact of individual characteristics, such as gender and nationality, but, since we cannot alter students' personal characteristics, the organizational variables are of greater policy interest. Our data suggest that, not only are the rates of observed misconduct department- and discipline-specific, but also that alterable characteristics of departmental environments condition the exposure of graduate students to a wide array of different forms of behavior that conflict with the image of "the good scientist." Our findings do not arise in a vacuum, nor do they contradict more

popular explanations for why science may be at an ethical cross-roads. Rather, they suggest specific arenas for attention to the scientific environment experienced by graduate students.

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Figure 1: Contexts of Academic Research

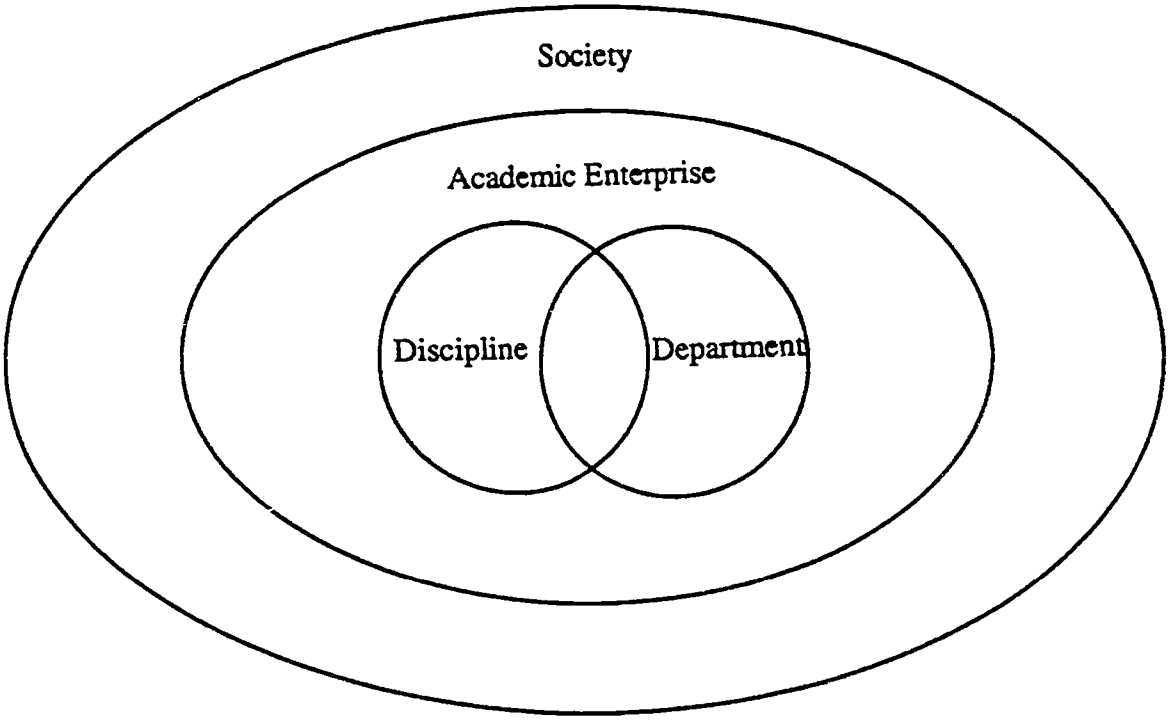

Table 1: Descriptive Statistics of Variables by Discipline

	Overall	Chemistry	Civil Engineering	Microbiology	Sociology	Test Statistic for Differences across Disciplines
Number of Respondents for This Analysis	1261	327	256	352	326	
Number of Departments	73	22	15	17	19	
Mean Number of Respondents per Department	17.27	14.86	17.07	20.71	17.16	
Proportion International	34.3	29.4	59.8	30.1	23.8	X^2=94.104 ***
Proportion Female	36.9	27.3	13.9	45.4	55.1	X^2=126.759 ***
Mean Years in Department (Standard Deviation)	2.94 (1.85)	2.82 (1.50)	2.63 (1.55)	2.79 (1.52)	3.48 (2.51)	F=13.097 ***

* : $p < .05$ ** : $p < .01$ *** : $p < .001$

Table 1: Descriptive Statistics of Variables by Discipline (continued)

	Overall	Chemistry	Civil Engineering	Microbiology	Sociology	Test Statistic for Differences
Mean All Misconduct (Standard Deviation)	6.64 (7.36)	7.28 (8.27)	5.03 (5.90)	6.73 (7.14)	7.17 (7.49)	F=5.5370 ***
Mean Research Misconduct (Standard Deviation)	2.26 (3.04)	2.52 (3.30)	1.89 (2.57)	2.36 (3.04)	2.18 (3.12)	F=2.2204
Mean Employment Misconduct (Standard Deviation)	2.19 (2.88)	2.51 (3.37)	1.79 (2.40)	2.54 (2.94)	1.82 (2.55)	F=6.6177 ***
Mean Personal Misconduct (Standard Deviation)	2.19 (2.73)	2.25 (3.05)	1.35 (1.88)	1.83 (2.28)	3.17 (3.07)	F=25.9026 ***

* : $p < .05$ ** : $p < .01$ *** : $p < .001$

Table 2: Correlation Coefficients

	All Miscond.	Res Miscond.	Employ Miscond.	Personal Miscond.	Years	Internat	Female	Chem	Civil	Micro	Sociol
All	1.0000										
Res	.8756**	1.0000									
Employ	.8651**	.6630**	1.0000								
Personal	.8066**	.5455**	.5373**	1.0000							
Years	.1435**	.0961**	.1238**	.1491**	1.0000						
Internat	-.1205**	-.0622*	-.1492**	-.0973**	-.0825**	1.0000					
Female	.0717*	.0126	.0121	.1658**	.0712*	-.1704**	1.0000				
Chem	.0510	.0498	.0648*	.0135	-.0386	-.0605*	-.1180**	1.0000			
Civil	-.1105**	-.0608*	-.0706*	-.1558**	-.0850**	.2698**	-.2382**	-.2986**	1.0000		
Micro	.0077	.0210	.0751**	-.0821**	-.0528	-.0550	.1101**	-.3682**	-.3141**	1.0000	
Sociol	.0426	-.0155	-.0770**	.2138**	.1712**	-.1300**	.2230**	-.3494**	-.2980**	-.3674**	1.0000
Feedback	-.3325**	-.2425**	-.2935**	-.3174**	-.1144**	-.0315	-.0123	-.0196	-.0286	.0681*	-.0240
Formal	-.3465**	-.2586**	-.3047**	-.3243**	-.1966**	.3523**	-.1677**	-.0790**	.2146**	.0099	-.1282**
Divest	.3709**	.2752**	.3112**	.3660**	.0922**	-.1081**	.1168**	.0525	-.1361**	.0283	.0427
Collab	-.0412	-.0013	.0053	-.1153**	-.1601**	.0239	-.1042**	.0947**	.0814**	.1756**	-.3527**
Size	-.0540	-.0409	-.0288	-.0695*	-.0790**	.0508	-.0760**	.1877**	-.0996**	.1057**	-.2046**
Contact	-.0591*	-.0341	-.0437	-.0752**	-.0278	-.2152**	-.0049	.1442**	-.0465	-.0165	-.0847**
Selfdir	-.1035**	-.1063**	-.0654*	-.0914**	.0085	-.1258**	.0430	-.0403	-.0206	-.0144	.0741**
Fixed	.0468	.0532	.0175	.0484	-.0083	.0261	.0310	.0619*	-.0602*	.1023**	-.1120**
Humane	-.3961**	-.2725**	-.3264**	-.4220**	-.1706**	.0234	-.0430	-.0221	.0560	.0597*	-.0908**
Compet	.3555**	.2403**	.2525**	.4251**	.1177**	-.0314	.0923**	-.1195**	.0238	-.1738**	.2790**
Solidar	-.0355	-.0192	-.0335	-.0388	-.0044	-.2170**	.0616*	.0764**	-.1000**	-.0095	.0248
Values	-.1449**	-.1471**	-.0905**	-.1316**	-.0195	.0709*	.0036	.0268	.0337	.0951**	-.1559**
Obligs	.0784**	.0513	.0449	.1069**	.0516	-.0263	.0392	-.0189	-.0764**	-.0280	.1178**
Exploit	.3161**	.2600**	.2748**	.2724**	.0714*	.0275	-.0042	.0616*	.0466	-.0109	-.0933**
Publish	-.1560**	-.1053**	-.0497	-.2510**	-.2051**	.0353	-.1167**	.2378**	.0277	.2438**	-.5143**
Indiv	.1281**	.0797**	.0839**	.1681**	.1008**	.0067	.0402	-.0954**	.0048	-.0780**	.1725**

* : $p < .05$ ** : $p < .01$

Table 2: Correlation Coefficients (con't.)

	Feedback	Formal	Divest	Collab	Size	Contact	Selfdir	Fixed	Humane	Compet	Solidar
Feedback	1.0000										
Formal	.3904**	1.0000									
Divest	-.4642**	-.4210**	1.0000								
Collab	.0879**	.1393**	-.0750**	1.0000							
Size	.0765**	.1196**	-.0197	.1558**	1.0000						
Contact	.1434**	.0315	-.1482**	.0333	.1085**	1.0000					
Selfdir	.1372**	.0937**	-.1023**	-.0209	.0020	.0451	1.0000				
Fixed	-.0948**	-.0824**	.1323**	.0755**	.0210	-.0631*	-.0697*	1.0000			
Humane	.4739**	.4883**	-.5366**	.1118**	.1340**	.2202**	.1967**	-.1491**	1.0000		
Compet	-.3600**	-.2912**	.3717**	-.1567**	-.1134**	-.2020**	-.0925**	.0767**	-.5033**	1.0000	
Solidar	.1715**	.0415	-.0897**	.0189	.0234	.3081**	.1084**	-.0144	.2543**	-.1074**	1.0000
Values	.1717**	.1526**	-.1874**	.1135**	.1014**	.1588**	.1230**	-.0100	.2327**	-.1603**	.3092**
Obligs	-.1091**	-.1385**	.2031**	-.0619*	-.1219**	-.0889**	-.0396	.1013**	-.1704**	.2003**	-.0016
Exploit	-.3530**	-.2402**	.4918**	.0225	-.0254	-.1070**	-.1592**	.1522**	-.4652**	.3233**	-.0922**
Publish	.3098**	.1988**	-.2368**	.2783**	.2029**	.1944**	.0798**	.0017	.3639**	-.3518**	.1484**
Indiv	-.1458**	-.1192**	.1930**	-.2511**	-.0868**	-.1107**	.0374	.0447	-.2361**	.2982**	-.0371

	Values	Obligs	Exploit	Publish	Indiv
Values	1.0000				
Obligs	-.0229	1.0000			
Exploit	-.0434	.2941**	1.0000		
Publish	.2198**	-.1663**	-.1395**	1.0000	
Indiv	-.0457	.1200**	.0885**	-.2491**	1.0000

* : $p < .05$ ** : $p < .01$

Table 3: Means, Standard Deviations, and Analyses of Variance for Scaled Variables

	Mean	Standard Deviation	F-Statistic for Analysis of Variance in Means across Departments
Misconduct Variables:			
Overall Misconduct	6.64	7.36	1.7539 ***
Research Misconduct	2.26	3.04	1.7052 ***
Employment Misconduct	2.19	2.88	1.7398 ***
Personal Misconduct	2.19	2.73	2.5307 ***
Structure Variables:			
Feedback	12.13	3.32	1.4611 **
Formality	15.21	3.65	3.1266 ***
Divestiture	12.56	3.76	1.7710 ***
Collaboration	.47	.50	4.2493 ***
Size	1.98	3.11	2.8106 ***
Contact	3.88	1.10	2.1959 ***
Self-Direction	4.01	.90	1.5736 **
Fixed	.33	.47	3.9620 ***
Climate Variables:			
Humane	13.29	4.56	2.6144 ***
Competitive	6.58	2.41	3.8764 ***
Solidarity	2.03	.78	2.1856 ***
Values	1.82	.67	1.6699 ***
Obligations	2.69	1.16	1.7973 ***
Exploitation	2.43	1.21	1.6346 ***
Publish	2.37	.72	10.9281 ***
Individualism	1.79	.86	2.2671 ***

* : $p \leq .05$ ** : $p \leq .01$ *** : $p \leq .001$

Table 4: Hierarchical Linear Model: Initial Department-Level Analysis, for Structure, Climate, and Discipline Variables Separately

General Equation:

$$\text{Misconduct} = B_0 + R$$

$$B_0 = C_{00} + C_{01}(\text{Department Variable 1}) + \ldots + C_{0k}(\text{Department Variable k}) + U_0$$

Parameter Estimates (Only Significant Effects Are Displayed)		All Misconduct	Research Misconduct	Employment Misconduct	Personal Misconduct
Structure					
Base (B_0)	Base (C_{00})	6.820 ***	2.397 ***	1.952 ***	2.474 ***
	Size			.078 *	
Climate					
Base (B_0)	Base (C_{00})	5.535 ***	1.916 ***	1.720 ***	1.931 ***
Discipline					
Base (B_0)	Base (C_{00})	7.183 ***	2.189 ***	1.799 ***	3.198 ***
	Chemistry			.702 *	-.976 ***
	Civil Engin.	-2.211 **			-1.841 ***
	Microbiology			.707 *	-1.378 ***

Significance Levels: + : $p < .08$ * : $p < .05$ ** : $p < .01$ *** : $p < .001$

Table 5: Hierarchical Linear Model: Individual-Level Analysis
(Only Significant Effects Are Displayed)

General Equation:

$$\text{Misconduct} = B_0 + B_1(\text{Years} - \overline{\text{Years}}) + B_2(\text{International}) + B_3(\text{Female}) + R$$

$$B_0 = C_{00} + U_0 \qquad B_2 = C_{20} + U_2$$

$$B_1 = C_{10} + U_1 \qquad B_3 = C_{30} + U_3$$

Parameter Estimates (Only Significant Effects Are Displayed; Variances Are in Parentheses)		All Misconduct	Research Misconduct	Employment Misconduct	Personal Misconduct
Base (B_0)	Base (C_{00})	7.135 ***	2.379 ***	2.433 ***	1.992 ***
		(3.207) **	(.667) ***	(.452) ***	(.471) *
Years	Base (C_{10})	.599 ***	.226 ***	.238 ***	.142 **
		(.372) *	(.066) *	(.066) *	(.051) *
International	Base (C_{20})	-1.569 **	-.351 +	-.798 ***	-.318 +
			(.536) +		(.334) *
Female	Base (C_{30})	-----	-----	-----	.791 ***

Significance Levels: + : $p < .08$ * : $p < .05$ ** : $p < .01$ *** : $p < .001$

Table 6: Hierarchical Linear Model: Equations for Full Analysis

Overall Misconduct [or Employment Misconduct] $= B_0 + B_1(\text{Years} - \overline{\text{Years}}) + B_2(\text{International}) + R$

$B_0 = C_{00} + C_{01}(\text{Department Variable 1}) + \ldots + C_{0k}(\text{Department Variable k}) + U_0$

$B_1 = C_{10} + C_{11}(\text{Department Variable 1}) + \ldots + C_{1k}(\text{Department Variable k}) + U_1$

$B_2 = C_{20}.$

Research Misconduct $= B_0 + B_1(\text{Years} - \overline{\text{Years}}) + B_2(\text{International}) + R$

$B_0 = C_{00} + C_{01}(\text{Department Variable 1}) + \ldots + C_{0k}(\text{Department Variable k}) + U_0$

$B_1 = C_{10} + C_{11}(\text{Department Variable 1}) + \ldots + C_{1k}(\text{Department Variable k}) + U_1$

$B_2 = C_{20} + C_{21}(\text{Department Variable 1}) + \ldots + C_{2k}(\text{Department Variable k}) + U_2.$

Personal Misconduct $= B_0 + B_1(\text{Years} - \overline{\text{Years}}) + B_2(\text{International}) + B_3(\text{Female}) + R$

$B_0 = C_{00} + C_{01}(\text{Department Variable 1}) + \ldots + C_{0k}(\text{Department Variable k}) + U_0$

$B_1 = C_{10} + C_{11}(\text{Department Variable 1}) + \ldots + C_{1k}(\text{Department Variable k}) + U_1$

$B_2 = C_{20} + C_{21}(\text{Department Variable 1}) + \ldots + C_{2k}(\text{Department Variable k}) + U_2$

$B_3 = C_{30}.$

Table 7: Hierarchical Linear Model: Full Analysis, for Structure, Climate, and Discipline Variables Separately

Parameter Estimates (Only Significant Effects Are Displayed)		All Misconduct	Research Misconduct	Employment Misconduct	Personal Misconduct
Structure					
Base (B_0)	Base (C_{00})			5.797 +	
	Feedback			-.301 *	
	Divestiture				.250 +
	Collaboration				-2.116 **
Years	Base (C_{10})				
	Feedback	-.363 +	-.192 *		
	Size	.416 *	.141 +	.186 *	
International	Base (C_{20})	-1.286 ** (fixed)	(fixed)	-.787 *** (fixed)	11.018 +
Female	Base (C_{30})	-----	-----	-----	.654 *** (fixed)

Significance Levels: + : $p < .08$ * : $p < .05$ ** : $p < .01$ *** : $p < .001$

Table 7: Hierarchical Linear Model: Full Analysis, for Structure, Climate, and Discipline Variables Separately (con't.)

Parameter Estimates (Only Significant Effects Are Displayed)		All Misconduct	Research Misconduct	Employment Misconduct	Personal Misconduct
Climate					
Base (B_0)	Base (C_{00})				
	Competitive	.952 *		.282 +	.355 +
	Publish			1.133 **	
	Solidarity				1.587 **
Years	Base (C_{10})			-2.938 *	
	Competitive	.520 *		.254 **	.190 *
	Obligations	-.954 *		-.370 *	-.396 *
	Publish	1.315 *		.608 **	
	Individualism	1.157 +		.425 +	
International	Base (C_{20})	-1.429 **		-.821 ***	
	Individualism				-1.571 *
		(fixed)	(fixed)	(fixed)	
Female	Base (C_{30})	-----	-----	-----	.658 *** (fixed)

Significance Levels: + : $p < .08$ * : $p < .05$ ** : $p < .01$ *** : $p < .001$

Table 7: Hierarchical Linear Model: Full Analysis, for Structure, Climate, and Discipline Variables Separately (con't.)

Parameter Estimates (Only Significant Effects Are Displayed)		All Misconduct	Research Misconduct	Employment Misconduct	Personal Misconduct
Discipline					
Base (B_0)	Base (C_{00})	7.473 ***	2.247 ***	1.972 ***	3.037 ***
	Civil Engin.	-1.740 *			-1.801 ***
	Chemistry			.762 **	-.897 **
	Microbiology			.752 **	-1.625 ***
Years	Base (C_{10})	.555 *		.183 +	.225 *
International	Base (C_{20})	-1.274 **		-.783 ***	-.831 *
	Microbiology				1.158 *
		(fixed)	(fixed)	(fixed)	
Female	Base (C_{30})	-----	-----	-----	.664 ***
					(fixed)

Significance Levels: + : $p < .08$ * : $p < .05$ ** : $p < .01$ *** : $p < .001$

Table 8: Hierarchical Linear Model: Full Analysis, Combining Significant Structure, Climate, and Discipline Variables
(All Parameter Estimates Are Displayed)

All Misconduct

Base (B_0)	Base (C_{00})	3.704 *
	Competitive	.565 *
	Civil Engineer.	-1.669 *
Years	Base (C10)	-2.102
	Feedback	-.217
	Size	.227
	Competitive	.433 *
	Obligations	-.829 *
	Publish	.893 +
	Individualism	1.203 *
International	Base (C20)	-1.311 **

Employment Misconduct

Base (B_0)	Base (C_{00})	2.136
	Feedback	-.356 ***
	Competitive	.287 *
	Publish	1.053 ***
	Chemistry	.334
	Microbiology	.626 *
Years	Base (C10)	-2.136 *
	Size	.112 +
	Competitive	.227 **
	Obligations	-.385 *
	Publish	.402 *
	Individualism	.421 +

Research Misconduct

Base (B_0)	Base (C_{00})	2.380 ***
Years	Base (C10)	1.875 *
	Feedback	-.148 *
	Size	.068
International	Base (C20)	-.326 +

Personal Misconduct

Base (B_0)	Base (C_{00})	-3.058
	Divestiture	.178 *
	Collaboration	.063
	Competitive	.394 **
	Solidarity	.354
	Chemistry	-.343
	Civil Engineering	-.804 +
	Microbiology	-.836 +
Years	Base (C10)	.164
	Competitive	.135 *
	Obligations	-.337 *
International	Base (C20)	1.747
	Individualism	-1.173 *
	Microbiology	.499
Female	Base (C30)	.618 **

Significance Levels: + : $p < .08$ * : $p < .05$ ** : $p < .01$ *** : $p < .001$

Appendix A: Survey Items Comprising Misconduct Scales

MISCONDUCT

In this program, have you observed or had other direct evidence of any of the following types of misconduct? Please indicate the number of graduate students and faculty members whose misconduct you have observed/experienced.

Number of Students: None (0), 1-2 (1), 3-5 (2), More Than 5 (3)
Number of Faculty: None (0), 1-2 (1), 3-5 (2), More Than 5 (3)

Research Misconduct = Sum of Student and Faculty Scores for the Following:

Plagiarizing
Falsifying or "cooking" research data
Inappropriately assigning authorship credit
Overlooking others' use of flawed research data or the questionable interpretation of data
Failing to present data that contradict one's previous research
Cheating in coursework (students only)

Employment Misconduct = Sum of Student and Faculty Scores for the Following:

Ignoring research policies (e.g., animal care, human subjects, biosafety, etc.)
Trying to get by on the work of others
Using university resources for outside consulting work or other inappropriate personal purposes
Misusing research funds

Personal Misconduct = Sum of Student and Faculty Scores for the Following:

Sexually harassing another person
Discriminating against others on the basis of race, ethnicity, gender, etc.
Using one's position to exploit or manipulate others

All Misconduct = Research + Employment + Personal Misconduct

Appendix B: Survey Items Comprising Structure and Climate Scales

STRUCTURE

Structured Feedback (alpha = .74)

Is there at least one faculty member (including your advisor, if appropriate) in your department who is particularly supportive of you and your work?
When your work is evaluated, how often do you find the evaluation constructive?
When your work is evaluated, how often do you find the evaluation promptly provided?
When your work is evaluated, how often do you find the evaluation detailed?
I am satisfied with the amount and quality of time spent with my advisor.

Formality (alpha = .62)

Evaluation of students successfully "weeds out" weak doctoral students.
Faculty members are explicit in their expectations of students.
Teaching assistants are carefully supervised by faculty.
Research assistants are carefully supervised by faculty.
My coursework has laid a good foundation for doing independent work.

Divestiture (alpha = .64)

When your work is evaluated, how often do you find the evaluation humiliating?
The advice and information I receive from faculty is inconsistent.
Faculty expect my responsibilities as a student to come before all other responsibilities.
Graduate school has positively reinforced my prior values, self-image, and way of thinking about the world. (reverse-coded)
Graduate school is changing me in ways I do not like.

Collaboration

Most students do their dissertation research as part of a larger, collaborative project.

Group Size

In a typical week, with how many faculty members, research associates, post-doctoral fellows, and graduate students do you work on research projects?

Contact

Students have little contact with each other. (reverse-coded)

Self-direction

Graduate students are encouraged to be self-directed.

Fixed

Most students have little choice as to which courses to take because of the number of required courses.

CLIMATE

Humane (alpha = .82)

Most faculty really care about their teaching.
Faculty make sure that students feel like members of the department.
People put their own interests first. (reverse-coded)
When conflicts arise, they are resolved quickly.
Students and faculty care about each other.
Graduate students are given an active role in departmental decisions that affect them.
The professional values of my professors are the same as mine.
There are tensions among faculty. (reverse-coded)
Graduate students are treated with respect.
Faculty seem more concerned with furthering their own careers than with the well-being of the department as a whole. (reverse-coded)

Competition (alpha = .68)

People have to compete for departmental resources.
A few students get most of the attention and resources.
Faculty are willing to bend the rules for some students, but not others.
Students have to compete for faculty time and attention.

Solidarity

There is a sense of solidarity among the students who enter the program at the same time.

Value Congruence

The professional values of other students in my department are the same as mine.

Obligations

My graduate assistant obligations are delaying my progress.

Exploitation

I often feel exploited by faculty.

Publications

Students and faculty collaborate on publications.

Individualism

This department values individual research over collaborative research.